REMARKS

By the present amendment, claims 7-12 are pending in the application. Claim 7 is independent.

Support For Claim Amendments

Claim 7

Support for the steel composition of amended independent claim 7 may be found in prior dependent claim 10.

§102/§103

Claims 7 to 12 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Kashima et al. (JP 10-176239, English abstract and machine translation) in view of Bates et al. ("Quenching of Steel", Vol. 4 ASM Handbook Online).

These rejections, as applied to the amended claims, are respectfully traversed for at least the reasons set forth below.

The Present Invention

The present invention is a claimed steel pipe with a small Bauschinger effect, comprising a steel base material having a dual-phase structure substantially comprising ferrite and fine martensite dispersed at the ferrite grain boundaries, wherein the steel pipe, after shaping and expansion, is heated at the austenite-ferrite dual-phase temperature region and quenched.

J.P. Patent No. 10-176239 (The '239 patent)

The technology disclosed in the '239 patent relates to a high strength and low yield ratio hot rolled steel sheet for pipe where the steel sheet contains C: 0.02-0.12%, Si: 0.1-1.5%, Mn $\leq$ 2.0%, P $\leq$ 0.05%, S: 0.01%, A1:0.01-0.10%, and Mo + Cr: 0.l-1.5%; optionally contains Cu, Ni, Ti, Nb, V, Ca, and a balance of Fe and unavoidable impurities; and has a structure composed of martensite and ferrite by 1-20 area %. See, Abstract. This hot rolled steel sheet is produced by the steps of: heating a slab at 1000-1300°C, hot rolling at a finish temperature of 750 -950°C, cooling with a cooling rate of 10-50°C/s, then coiling at 480-600°C. The steel sheet is subsequently formed into pipe, however, further heat treatment after pipe shaping is not suggested or disclosed in the '239 patent.

Patentability

The presently claimed steel pipe is heat treated, after pipe shaping and expansion, at a temperature corresponding to the austenite-ferrite dual-phase temperature region and then quenched. Applicants assert that there is no suggestion or disclosure of heat treatment after the pipe shaping in the '239 patent. The '239 patent is only directed to a hot rolled steel sheet.

Therefore, since the heat history of the instantly claimed steel pipe and the '239 steel pipe is very different, the steel microstructure and the occurrence of Bauschinger effect would necessarily be very different. The heat history makes the steel pipe of the present invention and the steel pipe of the '239 patent very different products.

The heat history defined in independent claim 7 results in a very different steel pipe product than a steel pipe disclosed or suggested in the '239 patent.

Attached Figs.

Attached hereto are Fig. A, Fig. B and Fig. C.

Fig. A is a stress-strain diagram for a stress-strain test for a steel pipe in accordance with the present invention.

Fig. B is a stress-strain diagram for a stress-strain test for a steel plate in accordance with the present invention and in accordance with the '239 patent.

Fig. C is a stress-strain diagram for a stress-strain test for a steel pipe in accordance with the '239 patent.

The X-axis or strain axis for Fig. A, Fig. B and Fig. C are the same. In Fig. A, the X-axis or strain axis is expressed as %. In Fig. B and Fig. C, the X-axis or strain axis is expressed as a non-dimensional decimal. It is readily apparent that the X-axis or strain axis of Fig. A, Fig. B and Fig. C are the same.

Fig. A

In Fig. A, a steel pipe of the present invention has been shaped and expanded (cold worked) from a steel plate in accordance with the present invention. After being shaped and expanded, the steel pipe was heated at the austenite-ferrite dual phase temperature region and then quenched, all in accordance with the present invention.

Fig. A shows that the steel pipe of the present invention which has been expanded and then heat treated after expansion at the austenite-ferrite dual phase temperature region and then quenched absorbs additional stress from an external load after reaching the yield point stress (i.e., exhibits plastic deformation or plastic working).

Fig. A shows that the steel pipe of the present invention does not begin to fracture after reaching the yield point stress. The steel pipe of the present invention exhibits

plastic working after reaching the yield point stress. Fig. A shows that the steel pipe of the present invention continues to absorb stress after reaching the yield point stress.

Fig. B

Fig. B is a stress-strain test diagram for a steel plate of the present invention and a steel plate of the '239 patent. The stress-strain characteristics are essentially the same. Fig. B shows that a steel plate in accordance with the present invention and a steel plate of the '239 patent each absorb additional stress from an external load after reaching the yield point stress (i.e., exhibit plastic deformation or plastic working).

Fig. C

In Fig. C, a steel pipe of the '239 patent has been shaped and expanded (cold worked) from a steel plate in accordance with the '239 patent. After the steel pipe of the '239 patent has been shaped and expanded, the steel pipe of the '239 patent is not heat treated.

The '239 patent does not disclose or suggest to heat treat a steel pipe after it has been shaped and expanded from a steel plate.

Fig. C shows that a steel pipe of the '239 patent, which is expanded but not heat treated after shaping and expansion, does not absorb additional stress from an external load after reaching the yield point stress (i.e., exhibits no plastic working or plastic deformation).

Fig. C shows that the steel pipe of the '239 patent begins to fracture immediately after reaching the yield point stress and does not exhibit plastic working. Fig. C shows that the stress absorbed by the steel pipe of the '239 patent becomes a maximum at about the yield point stress and then the stress decreases as the strain increases.

A comparison of Fig. A (present invention) and Fig. C ('239 patent) shows that steel pipes having essentially the same composition but having been subjected to different heat histories (present invention - specific heat treatment after shaping and expansion of the steel pipe; '239 patent - no heat treatment after shaping and expansion of the steel pipe) are steel pipe products which exhibit very different stress-strain curves.

The objective of the present invention is to provide a steel pipe with a small occurrence of the Bauschinger effect suitable for applications subject to external pressure.

The steel pipe of the '239 patent (no heat treatment after shaping and expansion) does not provide the effect of the present invention because the steel pipe of the '239 patent exhibits the stress-strain properties illustrated in Fig. C.

The steel pipe product of the present invention is very different from a steel pipe of the '239 patent.

Summary

Thus, the '239 patent does not render the claimed invention anticipated or obvious. Bates was only cited for the general knowledge that quenching of a heat treated steel product is known. This adds little to the disclosure of the '239 patent. Bates does not suggest heat treating and quenching the steel pipe of the '239 patent or the reasons or results of doing so.

It is therefore submitted that amended claims 7-12 are patentable. Applicants respectfully request reconsideration and withdrawal of the rejection of claims 7-12 over the '239 patent in view of Bates under §103(a).

CONCLUSION

It is submitted that in view of the present amendment and foregoing remarks, the application is now in condition for allowance. It is therefore respectfully requested that the application, as amended, be allowed and passed for issue.

Respectfully submitted,

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Dated: January 22, 2010

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